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Antenna (tuned)   DC Storage Capacitor

R (Modulator)

L   C   SW1   Modulator   Rectifiers   Cdc   R(chip)   Chip Load

V1

Figure 1: Prior Art Transponder
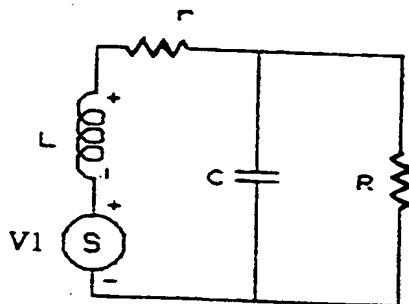
$1/Qt = 1/Qc + 1/Qi$

$Qc = wRC$ $Qi = wL/r$

$1/R = 1/R(modulator) + 1/R(chip)/2$

Figure 2: Tuned Circuit Model

diode

r

L   Ia   C   SW1   R(modulator)   Modulator   Cdc   Chip Load R(chip)

V1

Antenna (tuned)   Rectifiers
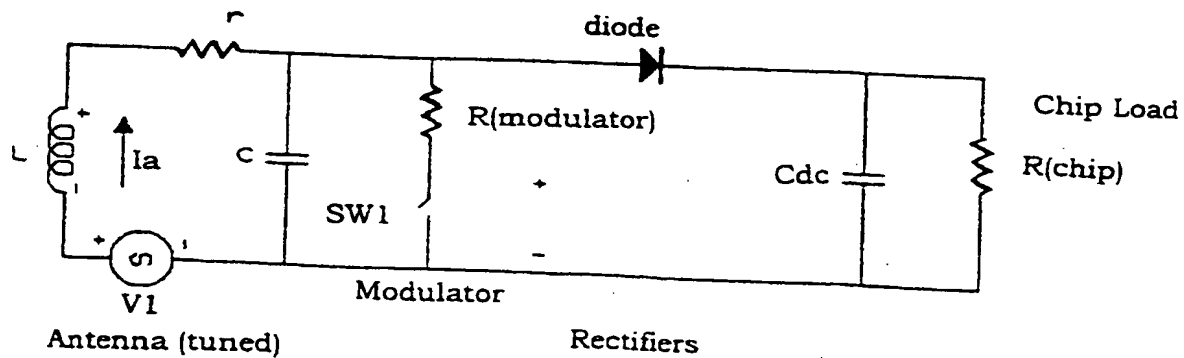
Figure 3: Electrical Model for Prior Art Circuit

$$1/Qt = 1/Qc + 1/Qi$$
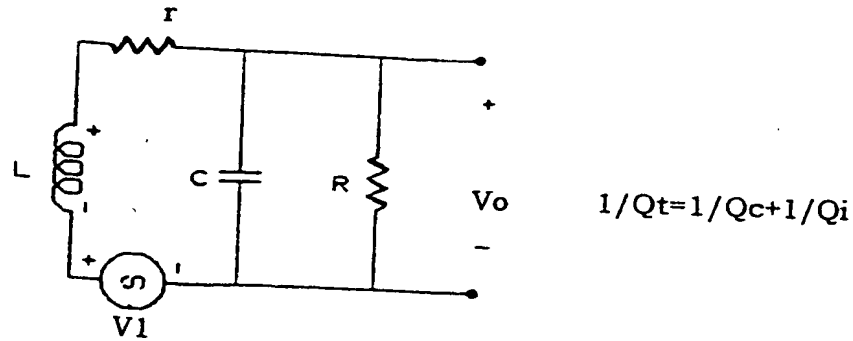
Figure 4(a): Data Rate Limited due to Q factor

Envelope Excitation

V1

Time

Envelope Antenna Voltage

Vo

$Ts = Qt.T/PI$

Ts

Time1
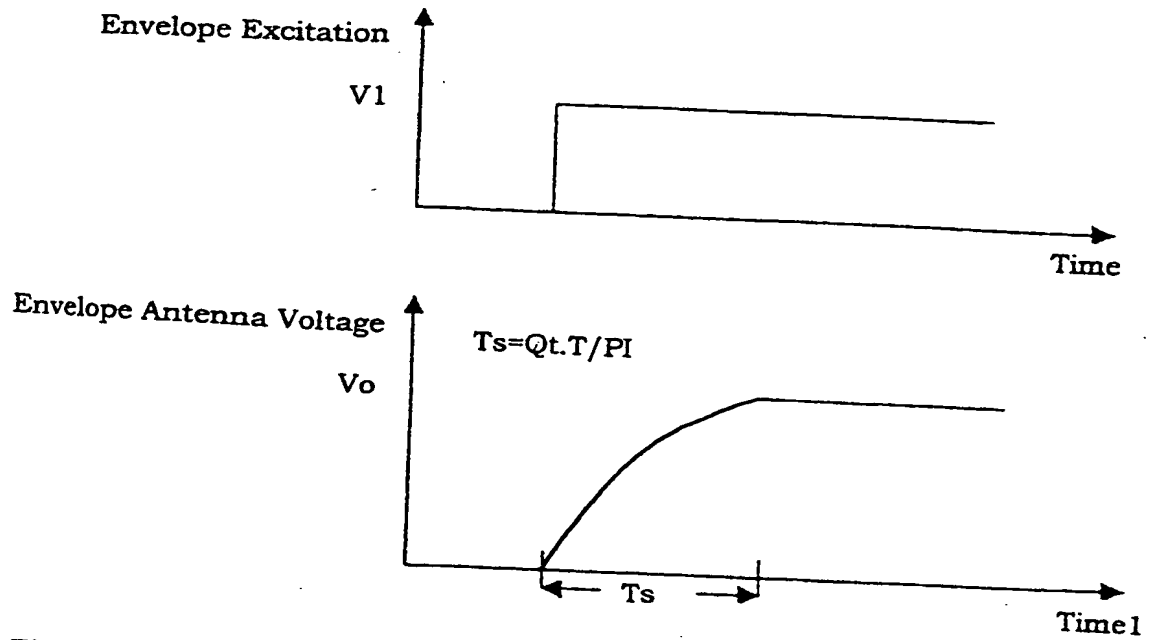
Figure 4(b): Envelope of Waveform associated with Q factor

Antenna (tuned)   I (diode)   I (diode)   Chip Load

Ia   R (Modulator)   Cdc   R (chip)   Idc

SW1

V1   Modulator   Rectifiers   DC Storage Capacitor
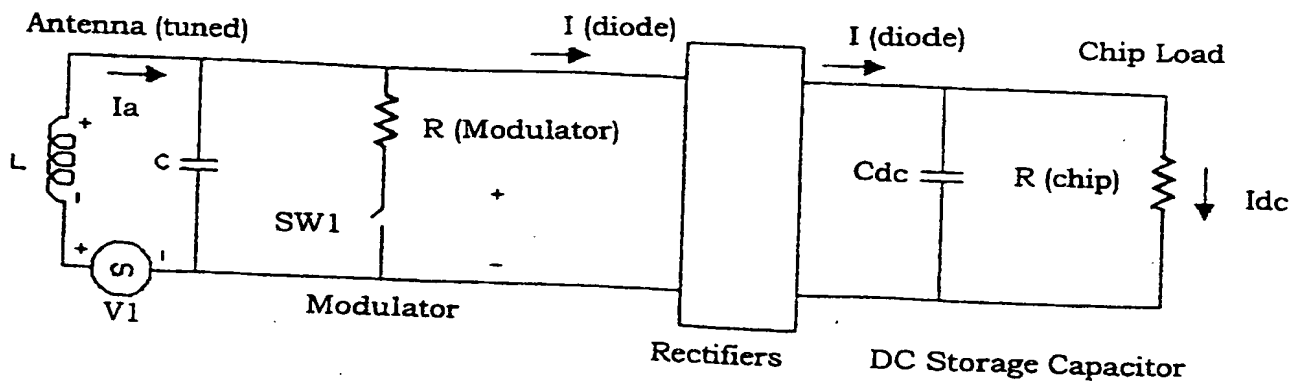
Figure 4(c): Data Rate Limit due to DC Storage System

Envelope Excitation

V1

dV1

Time

DC Capacitor Voltage

Vdc

$Tdc = (Cdc.dVdc.R(chip)/Vdc$

d(Vdc)

Tdc

Time
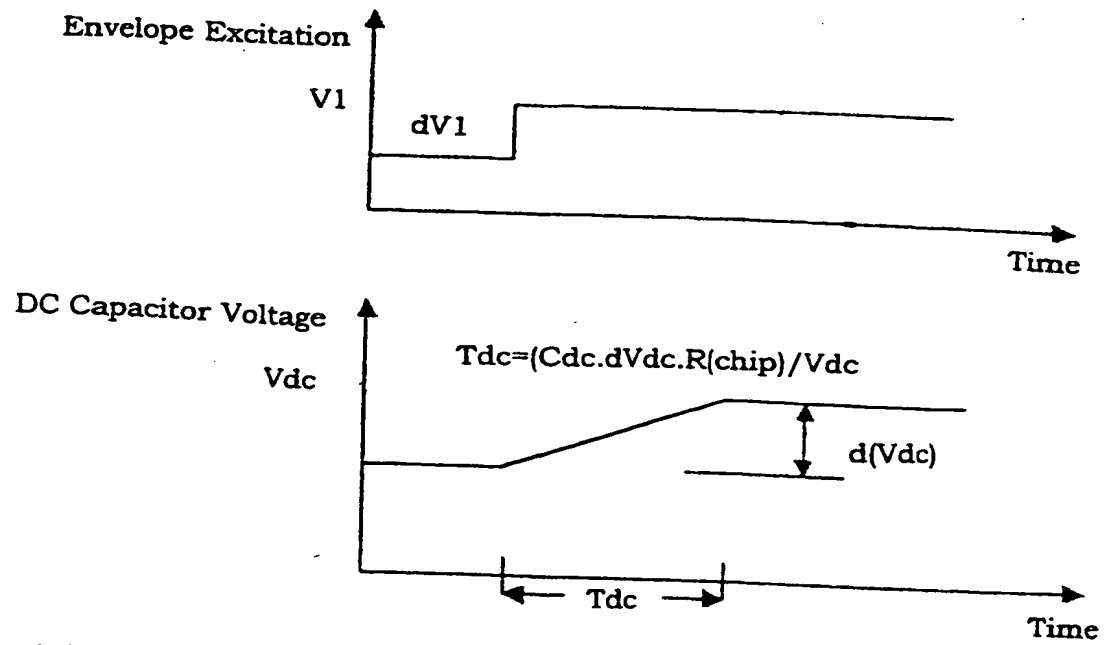
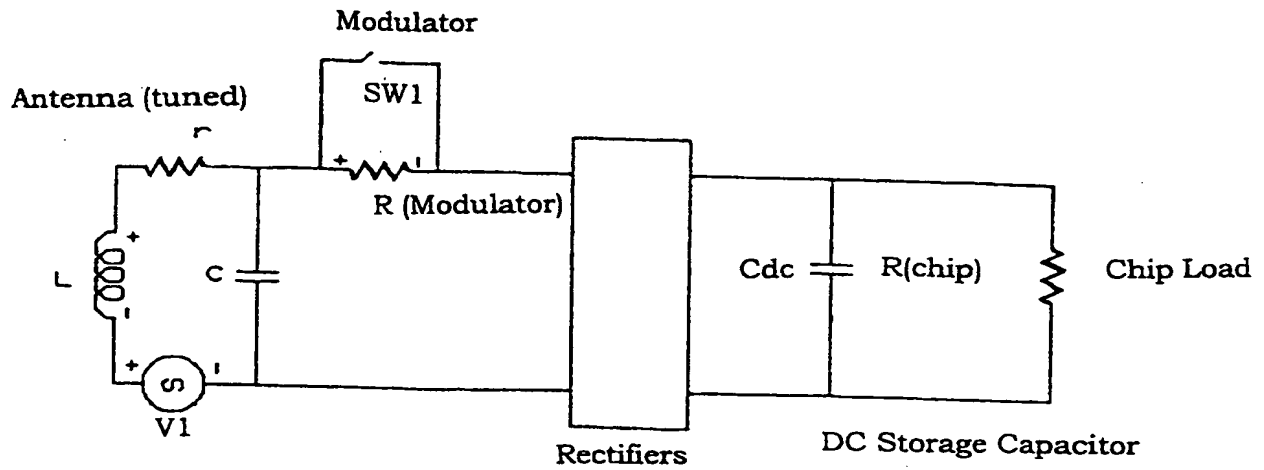Figure 4(d): DC Waveform associated with DC Storage Limit

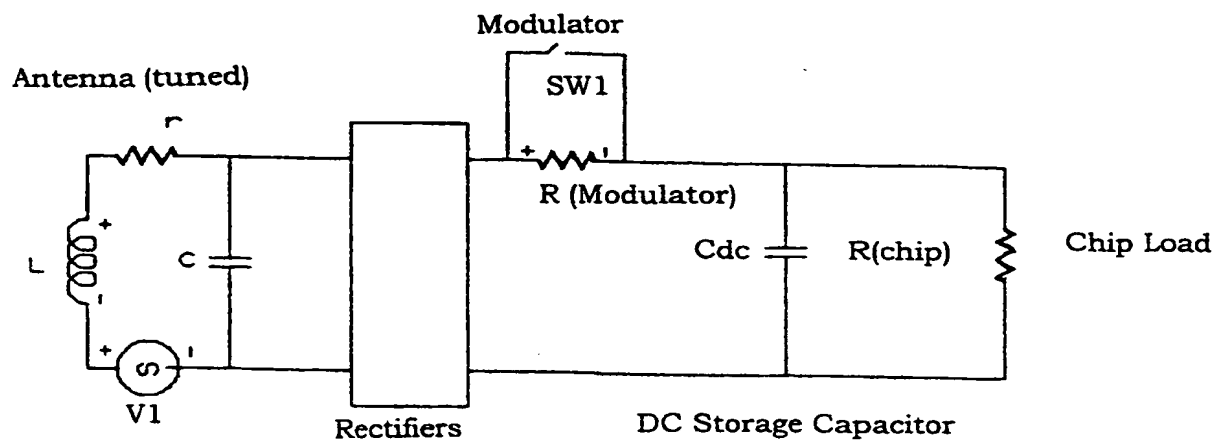**Figure 5(a): Invention with Modulator in AC part of Circuit**

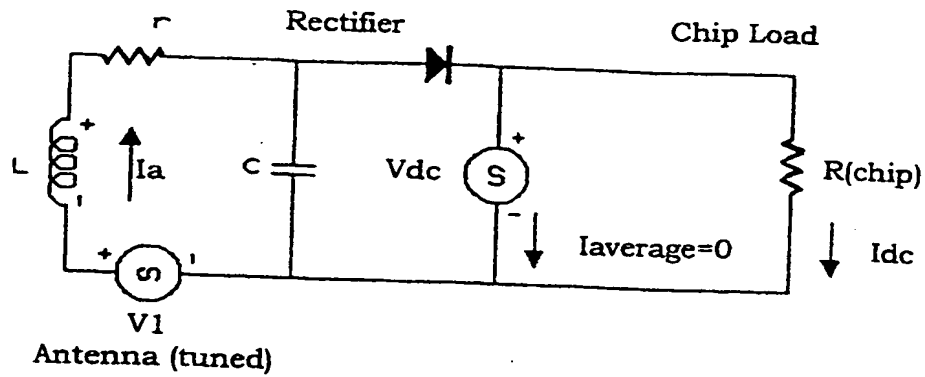**Figure 5(b): Invention with Modulator in DC part of Circuit**

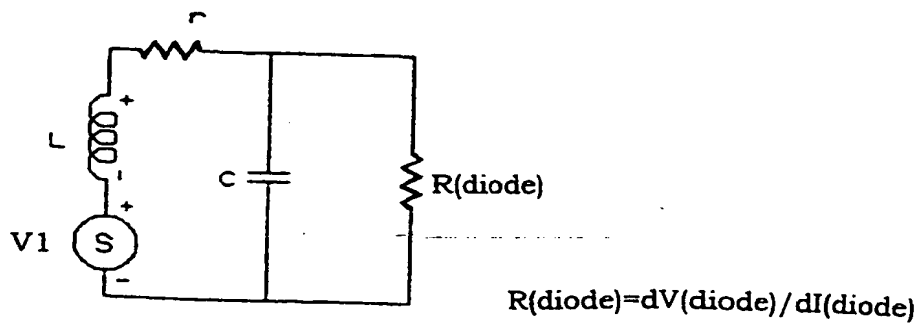**Figure 6(a): Electrical Model for Invention with SW1 Closed**

$R(diode)=dV(diode)/dI(diode)$

Figure 6(b): Electrical Model for Invention with SW1 Closed
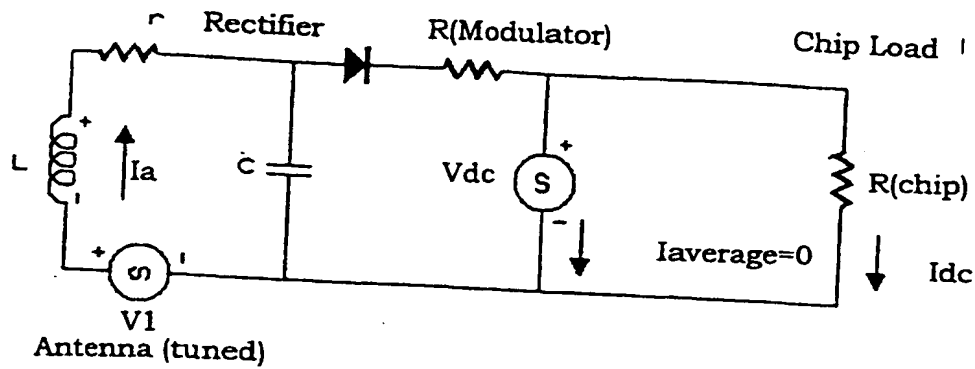
Figure 7(a): Electrical Model for Invention with SW1 Open

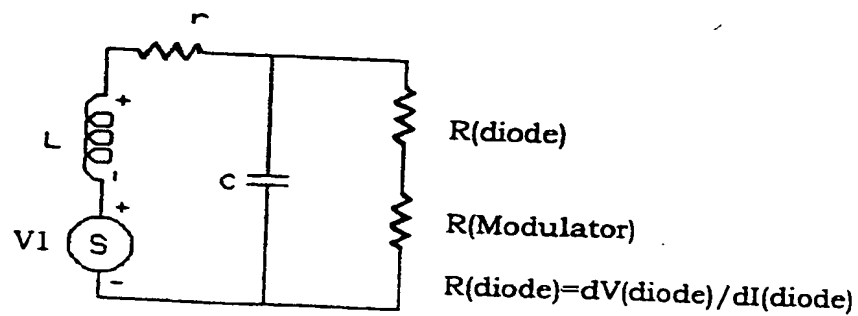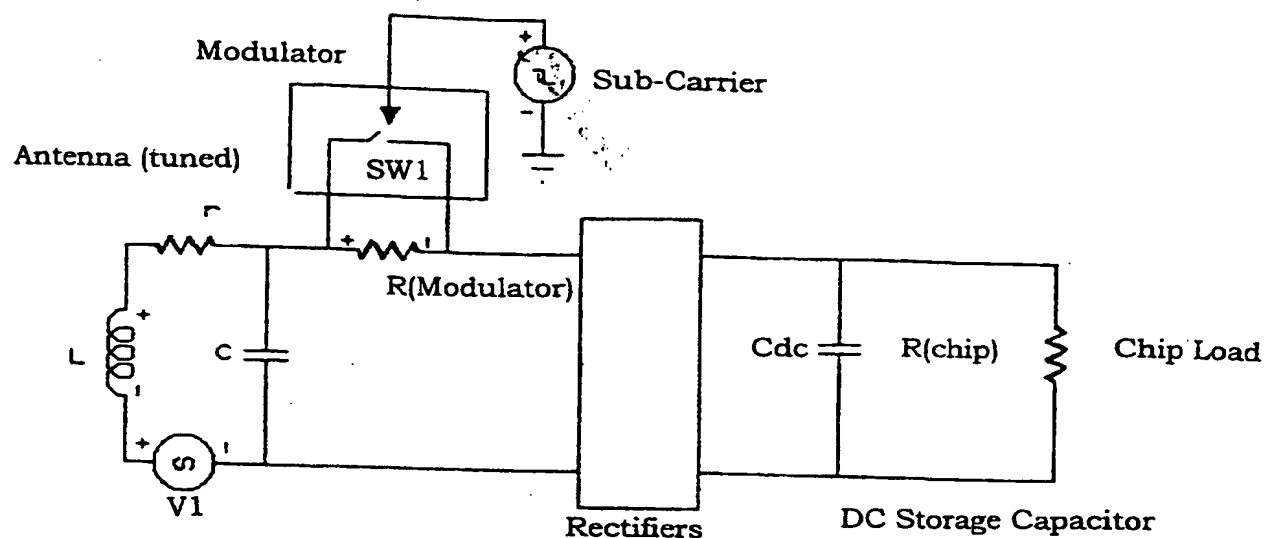**Figure 7(b): Electrical Model for Invention with SW1 Open**

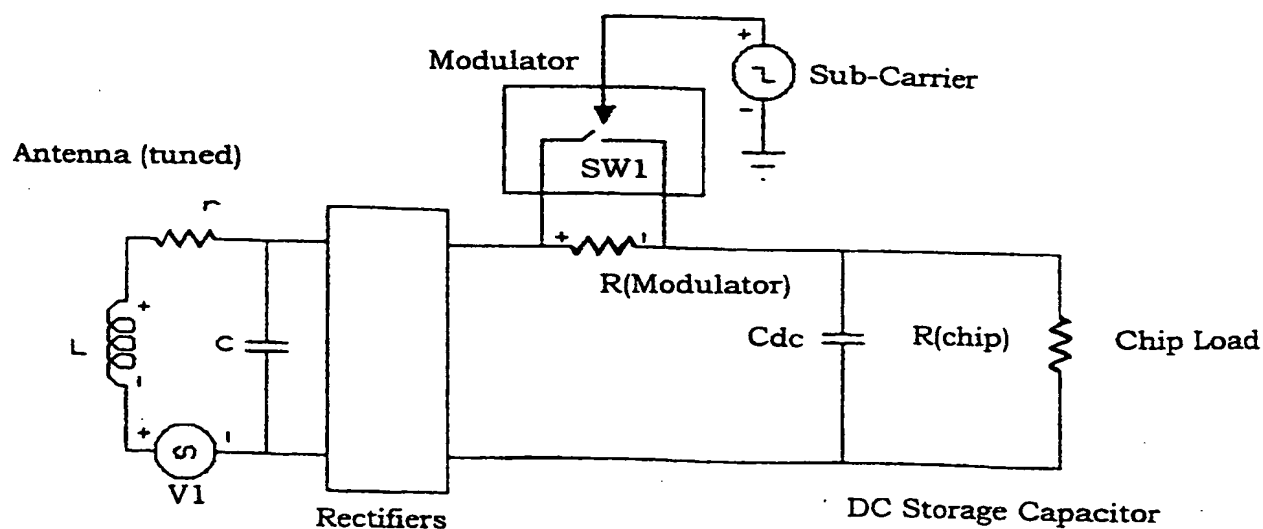**Figure 8(a):** Invention with Sub-Carrier Modulation of Modulator in AC Circuit

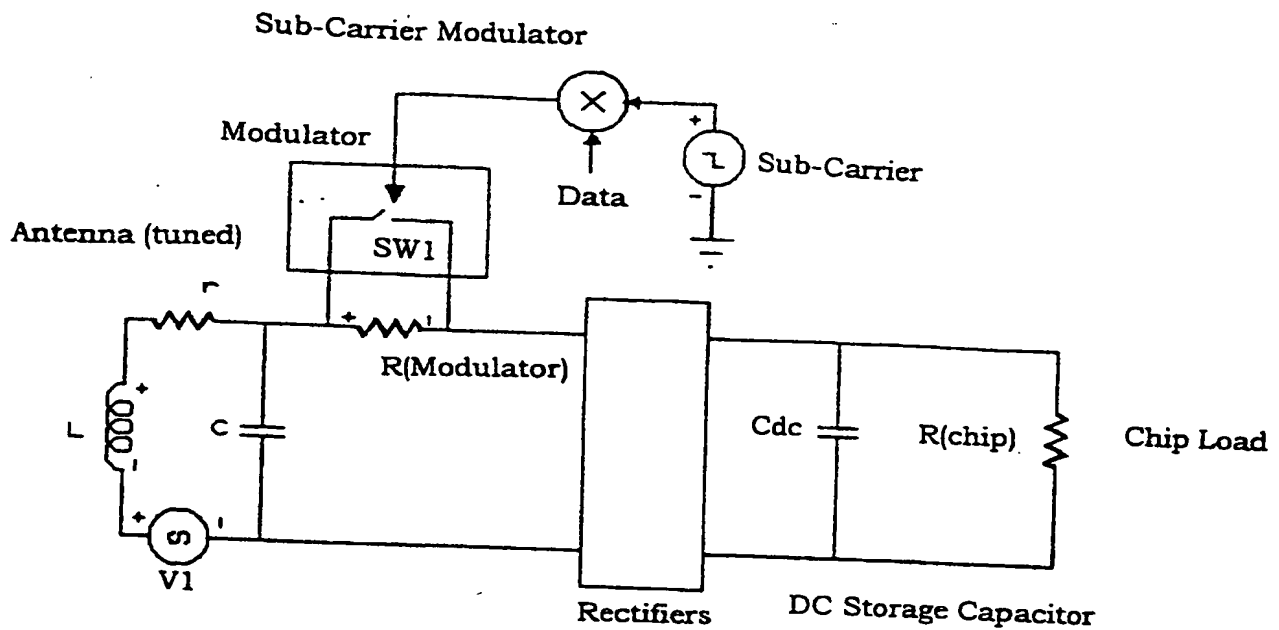**Figure 8(b):** Invention with Sub-Carrier Modulation of Modulator in DC Circuit
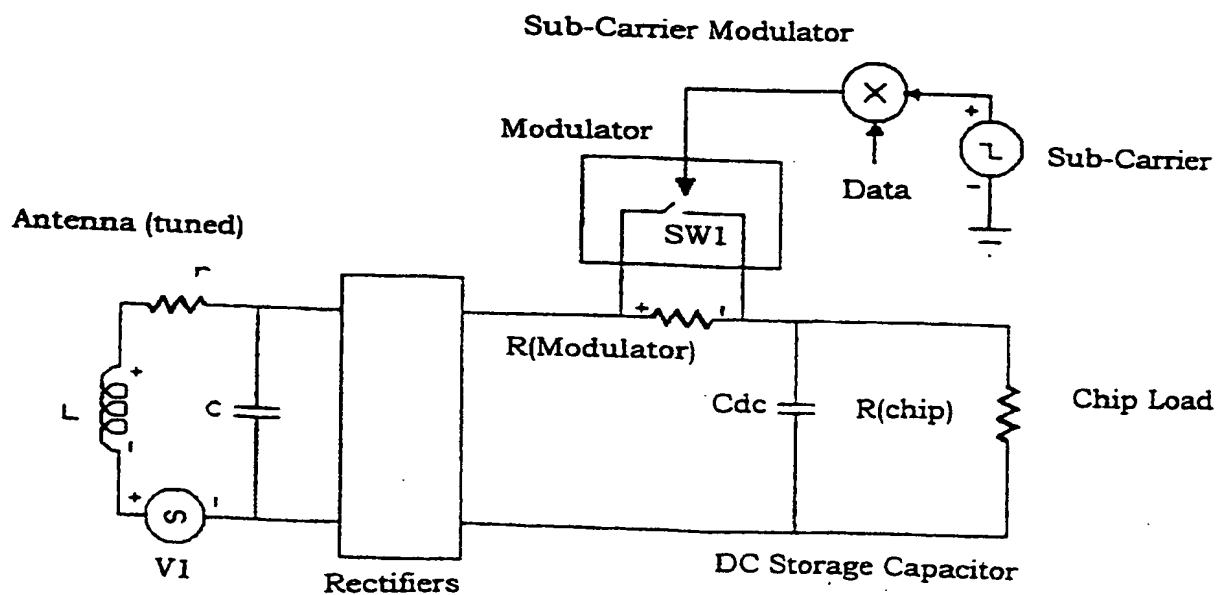
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Sub-Carrier Modulator

Figure 9(a): **Invention with Data Modulated onto Sub-Carrier with Modulator in AC Circuit**

Sub-Carrier Modulator

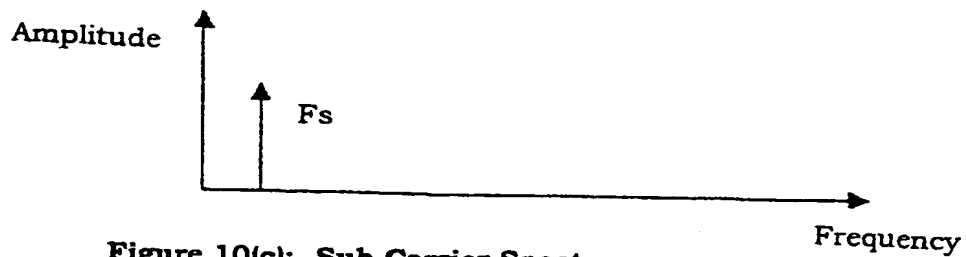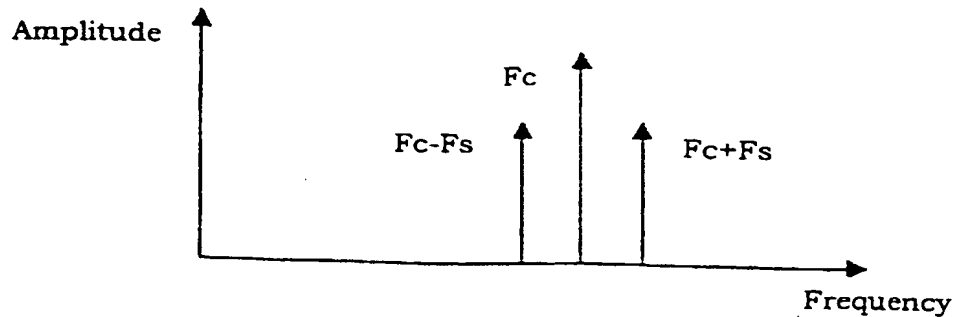Figure 9(b): **Invention with Data Modulated onto Sub-Carrier with Modulator in DC Cirucit**

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Open

Close

Time
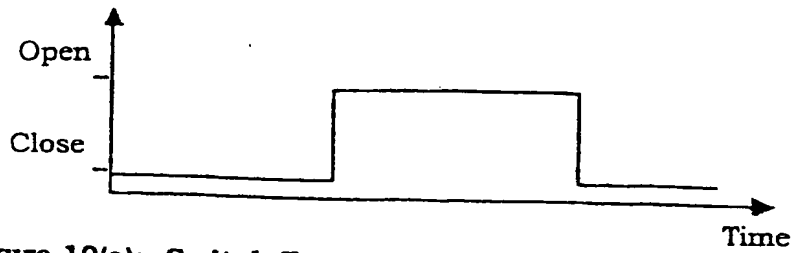
Figure 10(a): Switch Function

$V2 = Vdc + (diode) + I(diode).R(Modulator)$
$V1 = Vdc + V(diode)$

V2

V1

Time
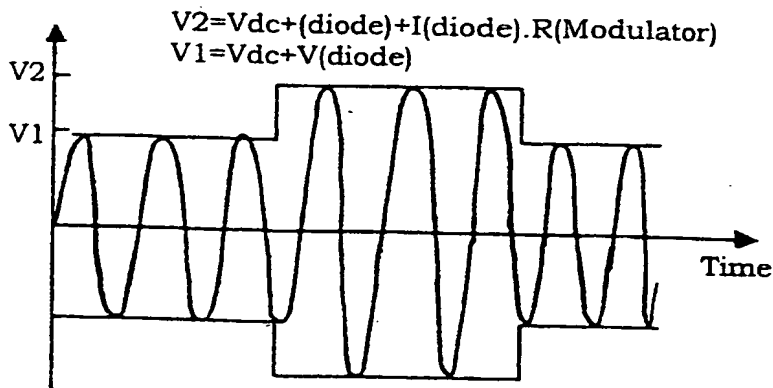
Figure 10(b): Antenna Voltage

Amplitude

Fs

Frequency

Figure 10(c): Sub-Carrier Spectrum

Amplitude

Fc

Fc-Fs

Fc+Fs

Frequency

Figure 10(d): Sub-Carrier Amplitude Modulation Sidebands

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Amplitude

Frequency

Figure 10(e): Data Spectrum

Amplitude

Fs

Frequency

Figure 10(f) Data Spectrum Modulated onto Sub-Carrier

Amplitude

Fc-Fs   Fc   Fc+Fs
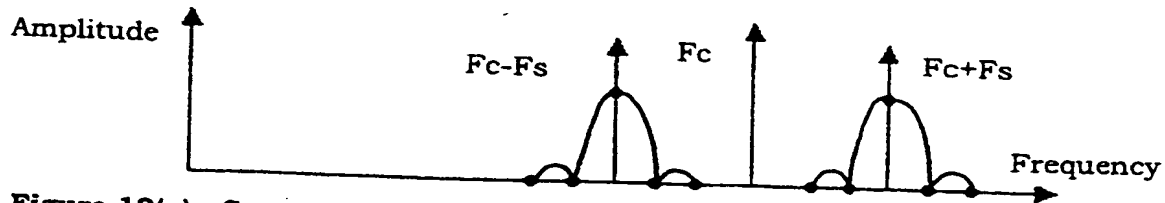
Frequency

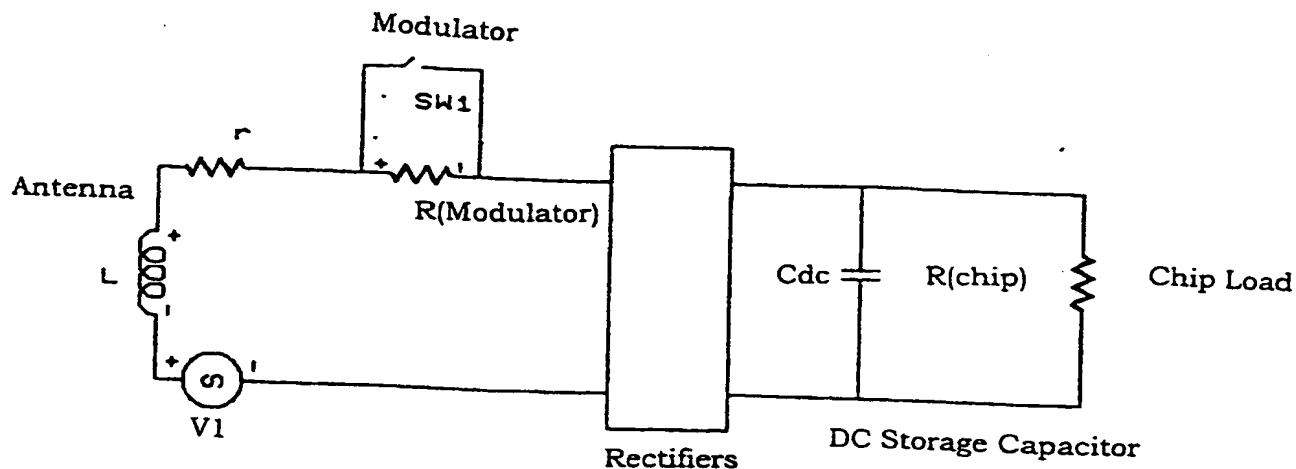**Figure 10(g): Spectrum Data Modulated Sub-Carrier Amplitude Modulated onto Excitation Frequency**

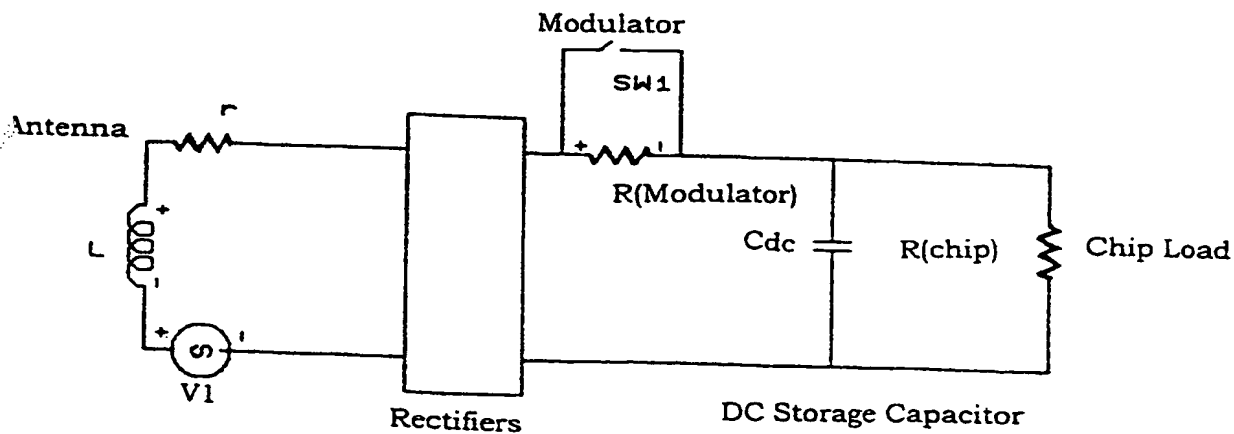Figure 11(a): Invention with Modulator in AC part of Circuit where Antenna is Untuned

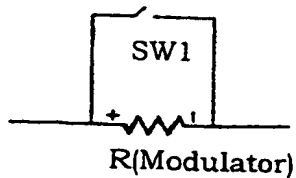Figure 11(b): Invention with Modulator in DC part of Circuit where Antenna is Untuned

Figure 12(a) Simple Switch Modulator
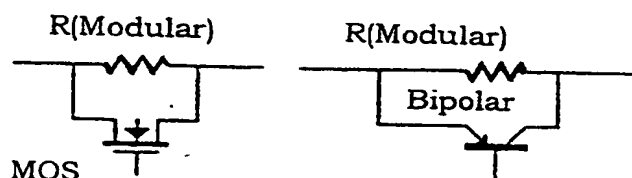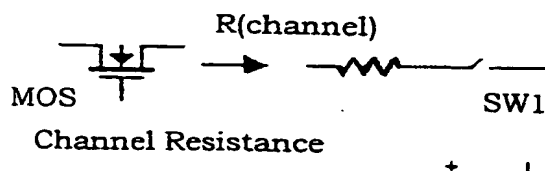

Figure 12(b): Examples of Modulation Swtitches

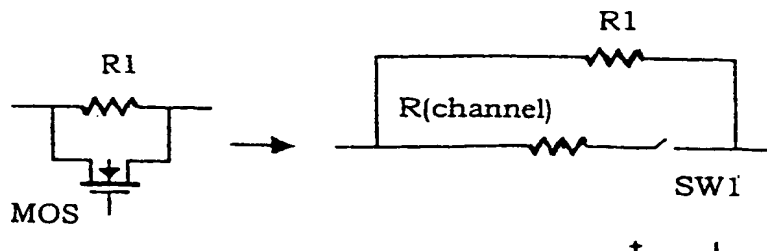Figure 12(c): Use of Channel Resistance to make Switchable Resistances
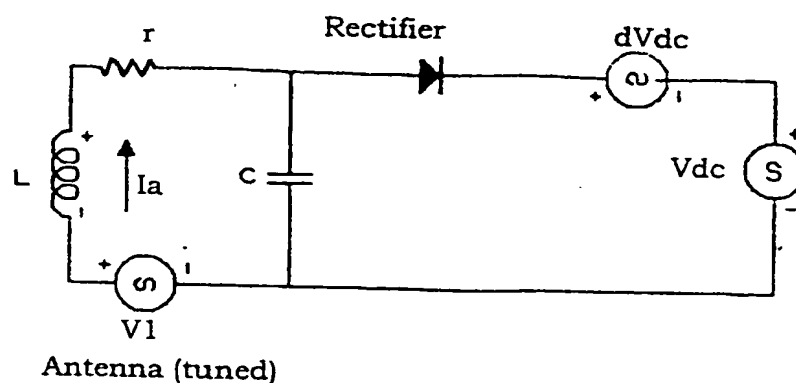

Figure 12(d): Resistance varied between Two Values

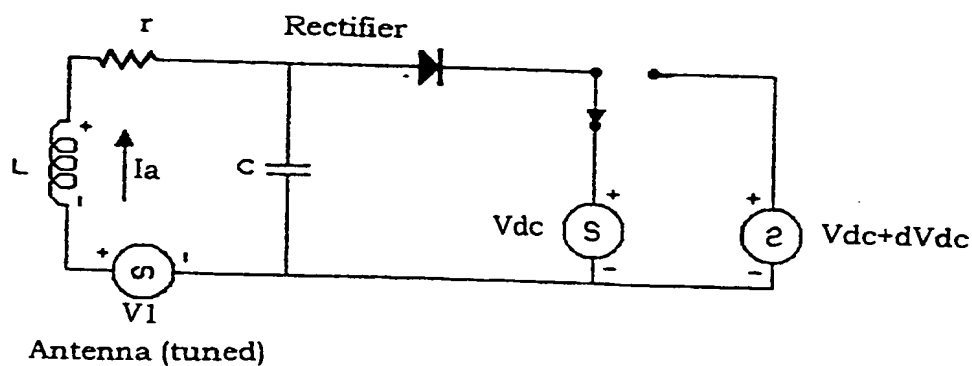**Figure 13(a): Electrical Model for Small change in DC Storage Voltage**

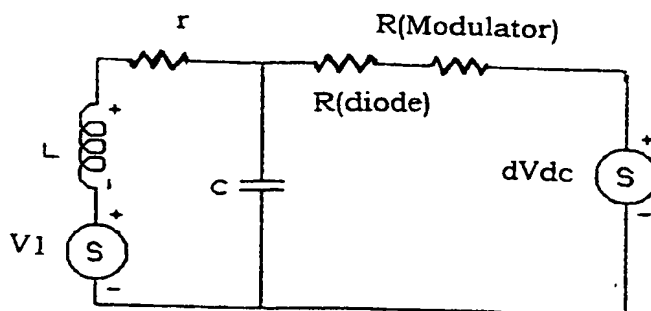**Figure 13(b): Electrical Model for Step Change in DC Voltage**

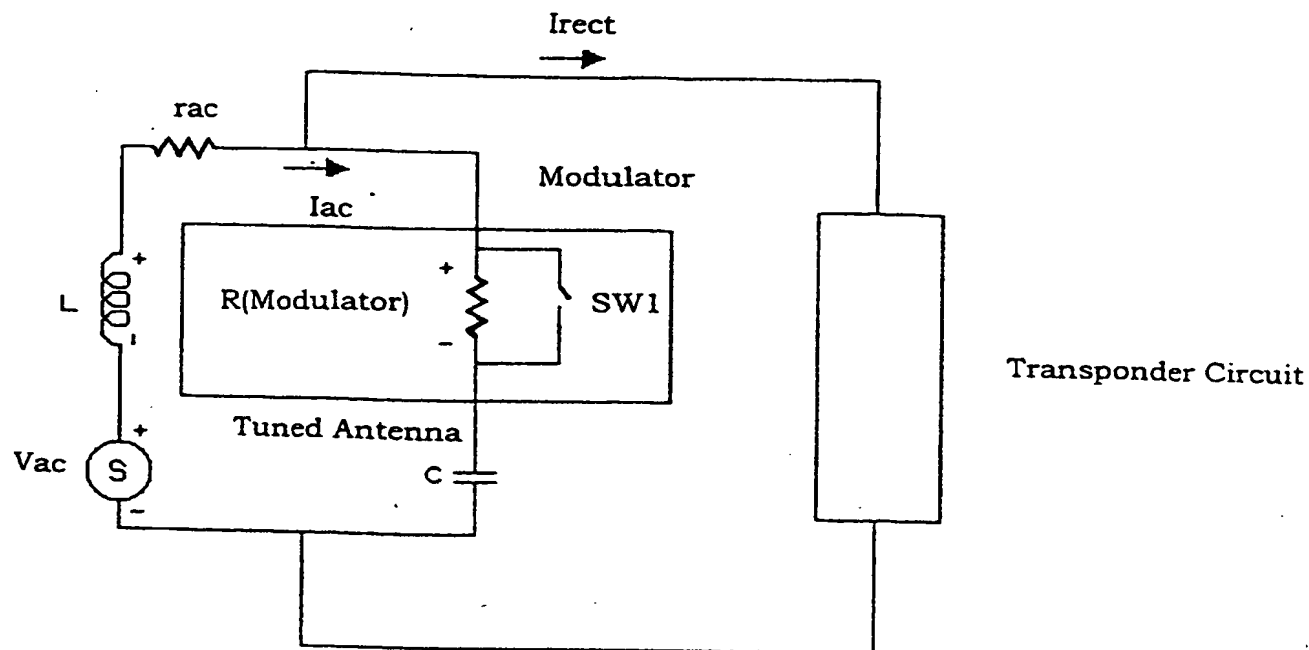**Figure 14: Electrical Model for Compensation Theorem Derive Modulator**

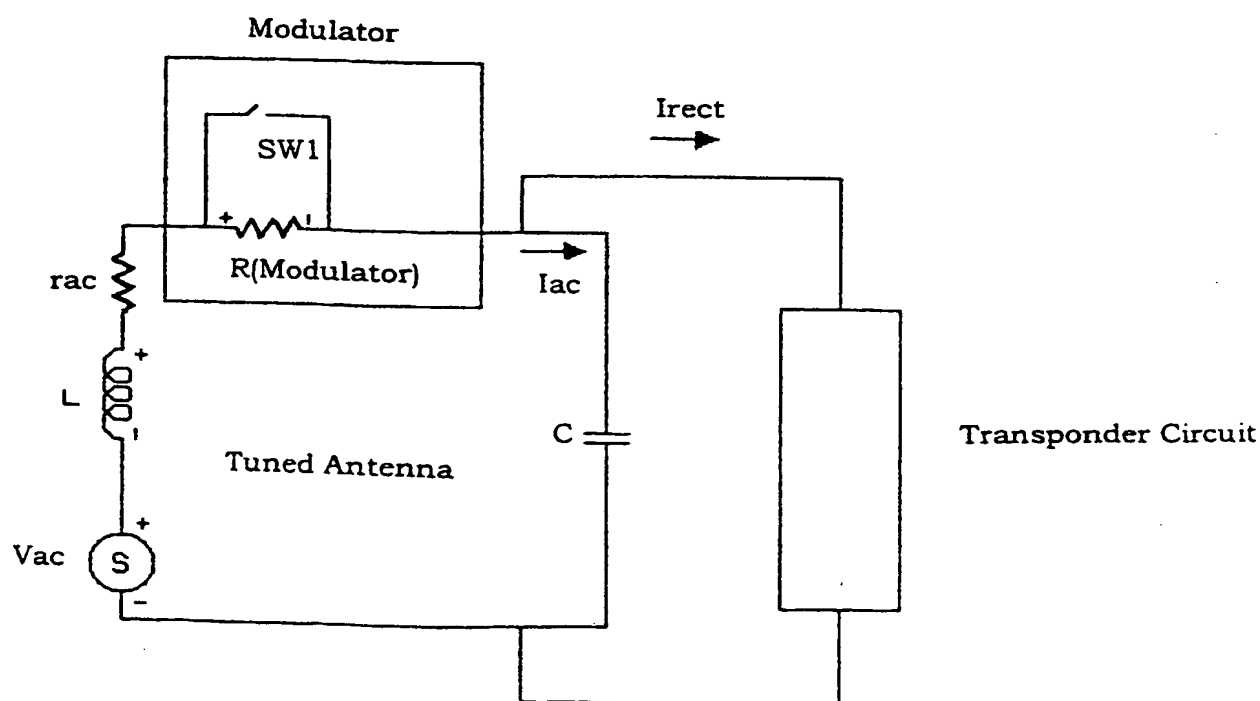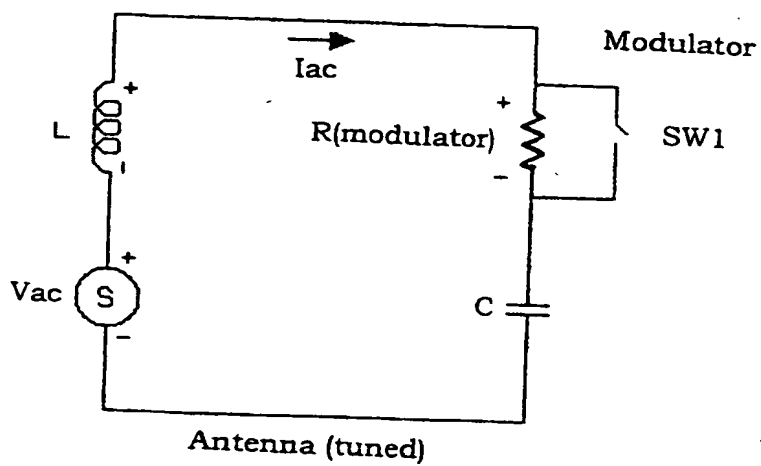**Figure 15(a): Invention with Transponder connected across Coil**

Figure 15(b): Invention with Transponder connected across Tuning Capacitor

Figure 16: Embodiment of Invention

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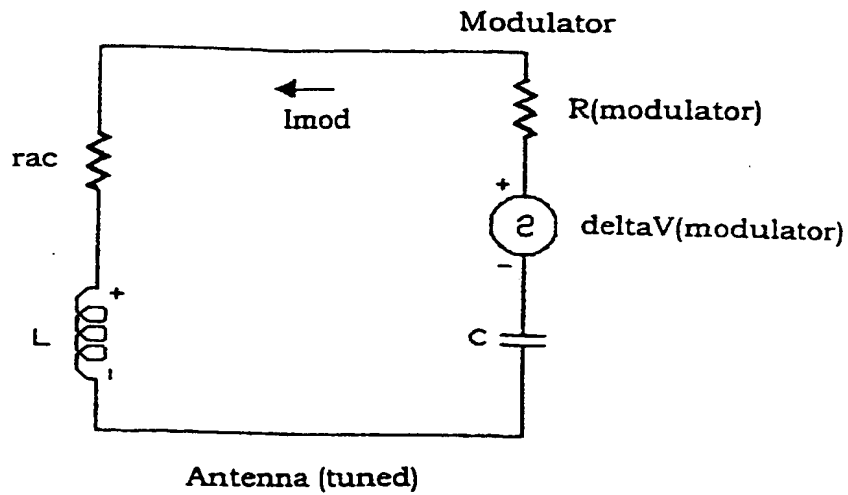
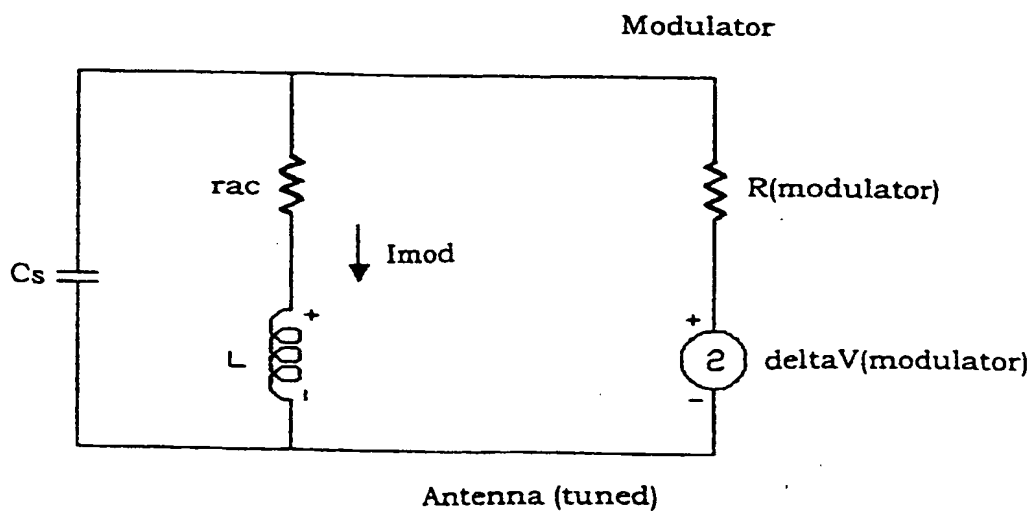Figure 17(a): Electrical Model of the Invention at Tuned Frequency

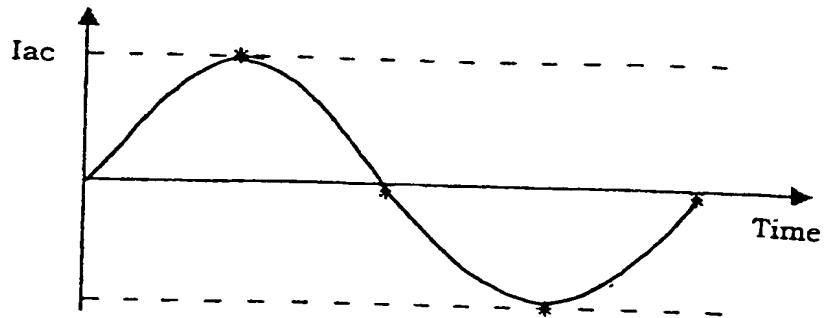Figure 17(b): Electrical Model of the Invention at Radio Frequency
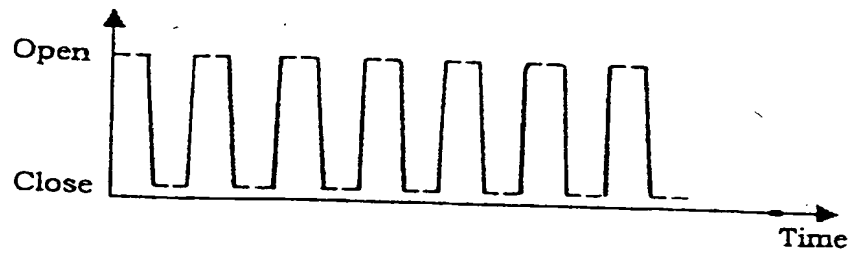
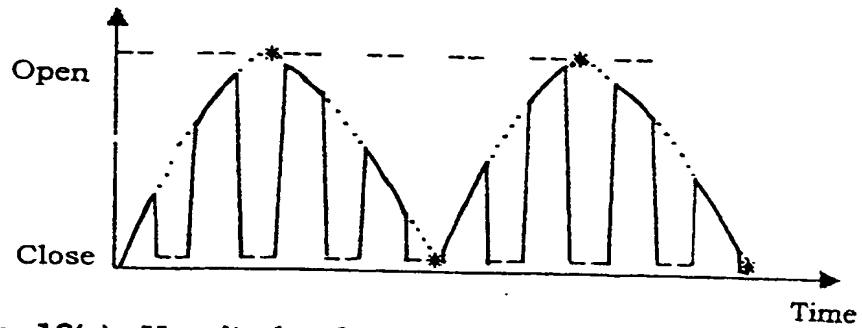**Figure 18(a): Coil Resonant Current Iac**

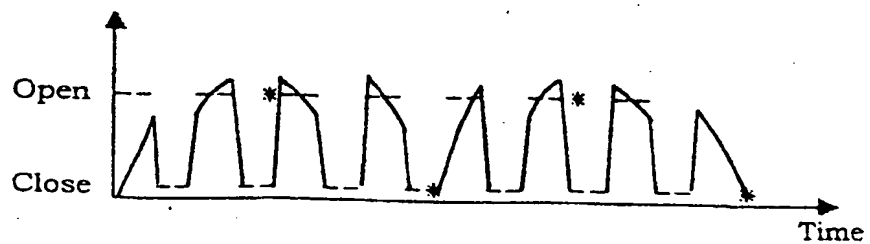**Figure 18(b): Switch Function**

Figure 18(c): Magnitude of V(modulator)

Figure 18(d): Magnitude of V(modulator) with Waveshaping

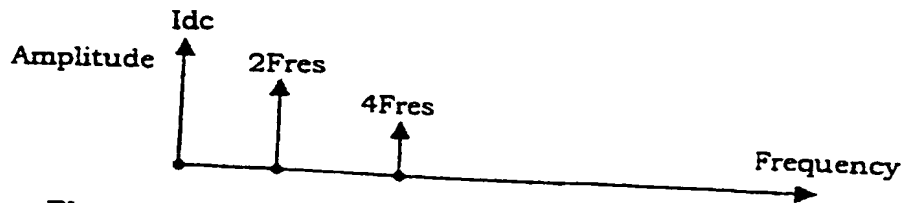Amplitude — Idc — 2Fres — 4Fres — Frequency

Figure 19(a): Spectrum of Iac Fullwave Rectified

Amplitude — Fc — Frequency
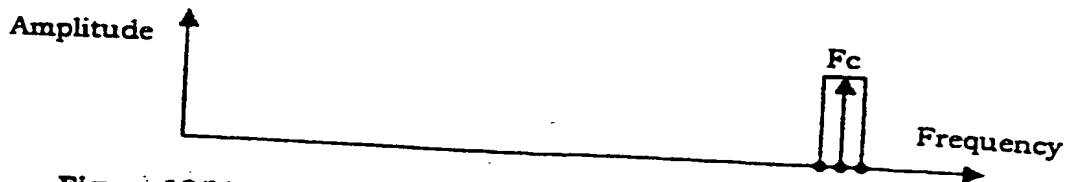
Figure 19(b): Carrier Modulated with Data

Amplitude — Fc-4Fres — Fc-2Fres — Fc — Fc+2Fres — Fc+4Fres — Frequency
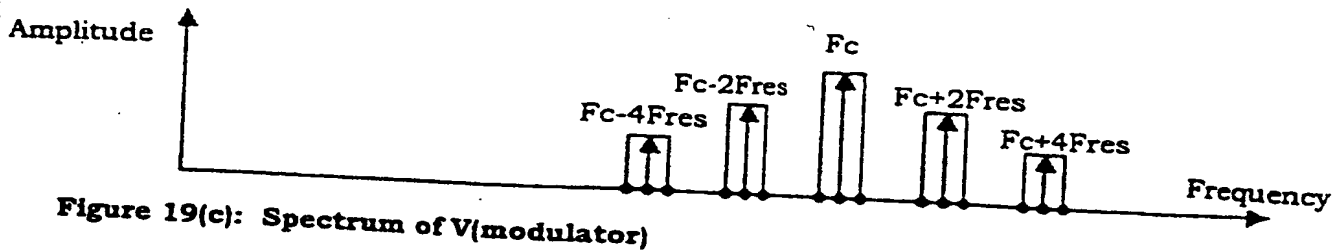
Figure 19(c): Spectrum of V(modulator)

Amplitude — Fc-4Fres — Fc-2Fres — Fc — Fc+2Fres — Fc+4Fres — Frequency
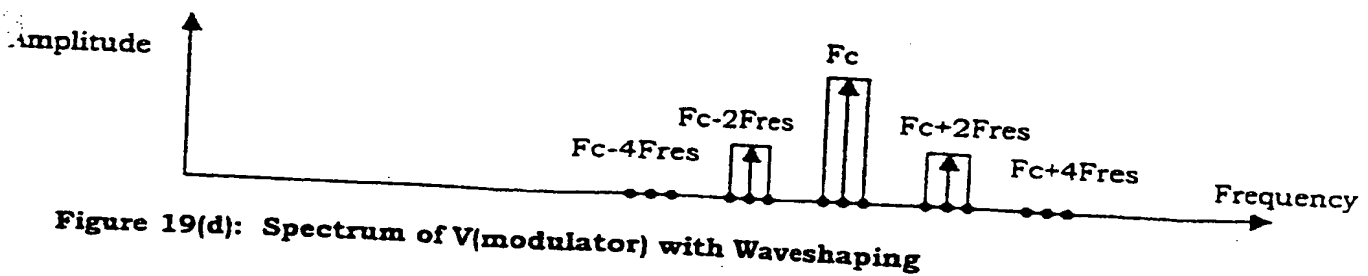
Figure 19(d): Spectrum of V(modulator) with Waveshaping
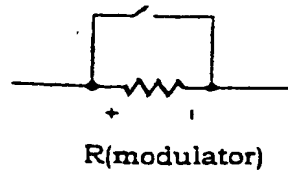
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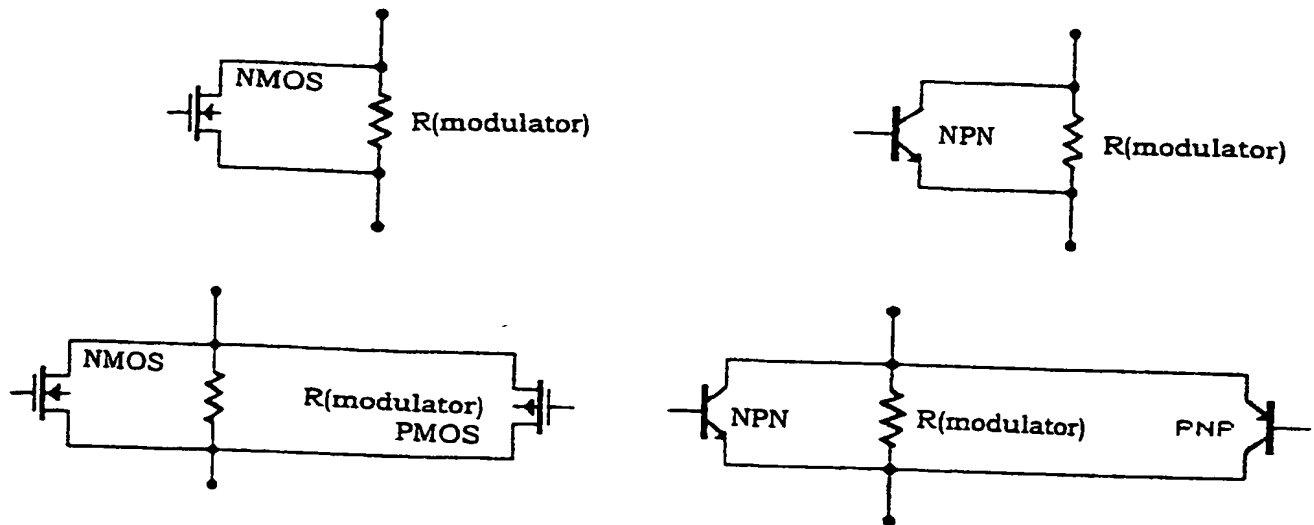Figure 20(a): Simple Switch Modulator
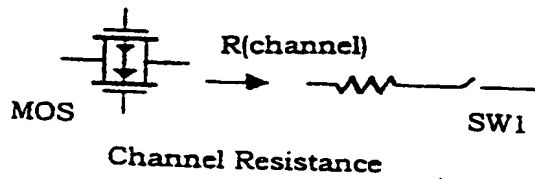

Figure 20(b): Examples of Modulation Switches

Figure 20(c): Use of Channel Resistance to make Switchable Resistances
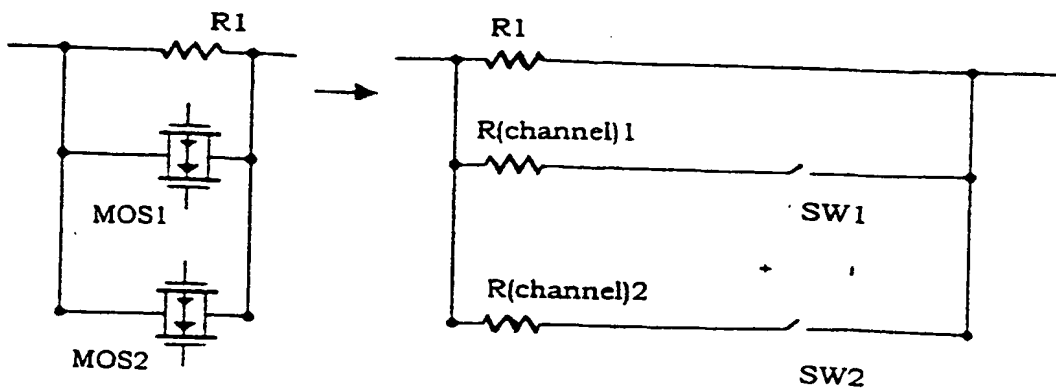

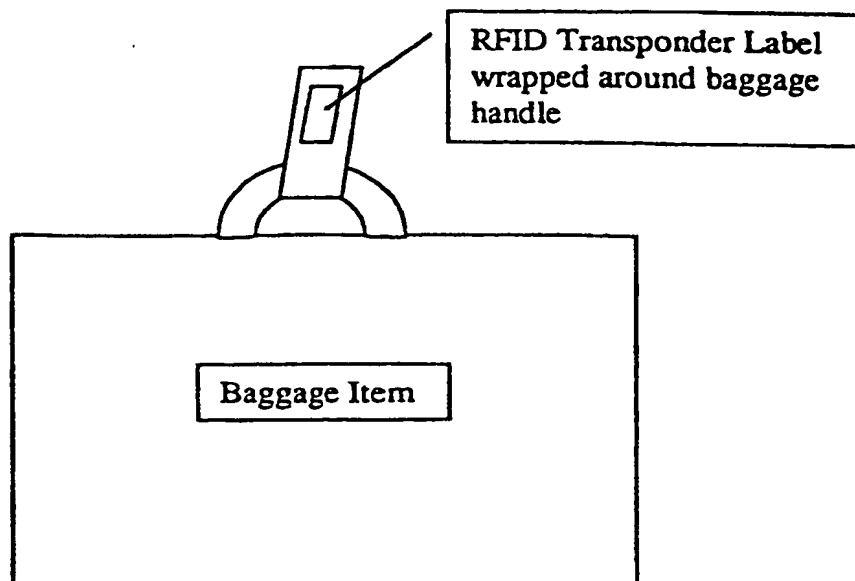Figure 20(d): Resistance varied between several values

Figure 21: Circuit embodiment of Invention

RFID Transponder Label wrapped around baggage handle

Baggage Item

Figure 22 : Baggage item with RFID transponder label

Label unfolded to show transponder
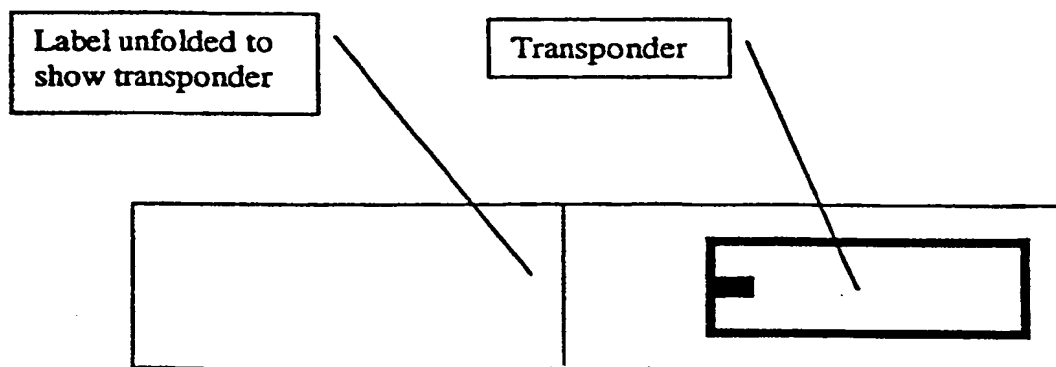
Transponder

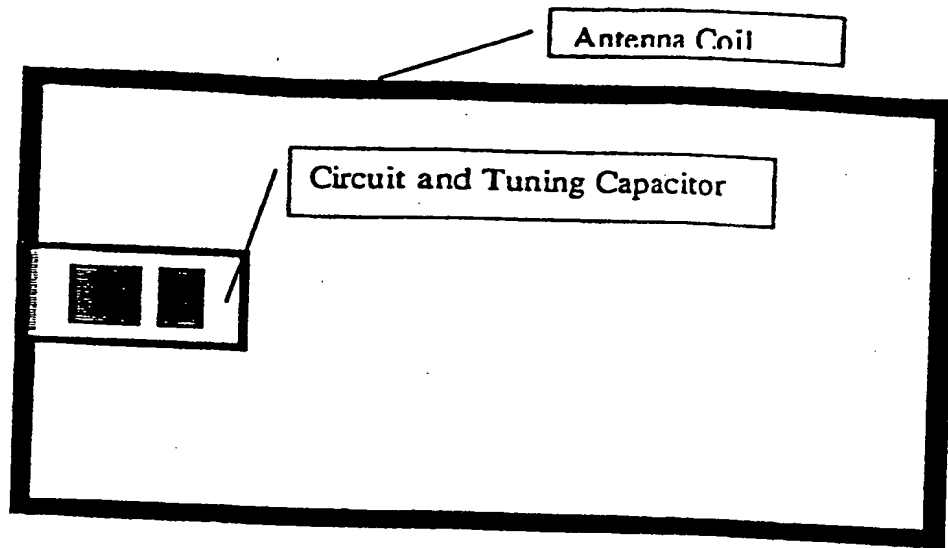Figure 23 : RFID transponder on baggage label
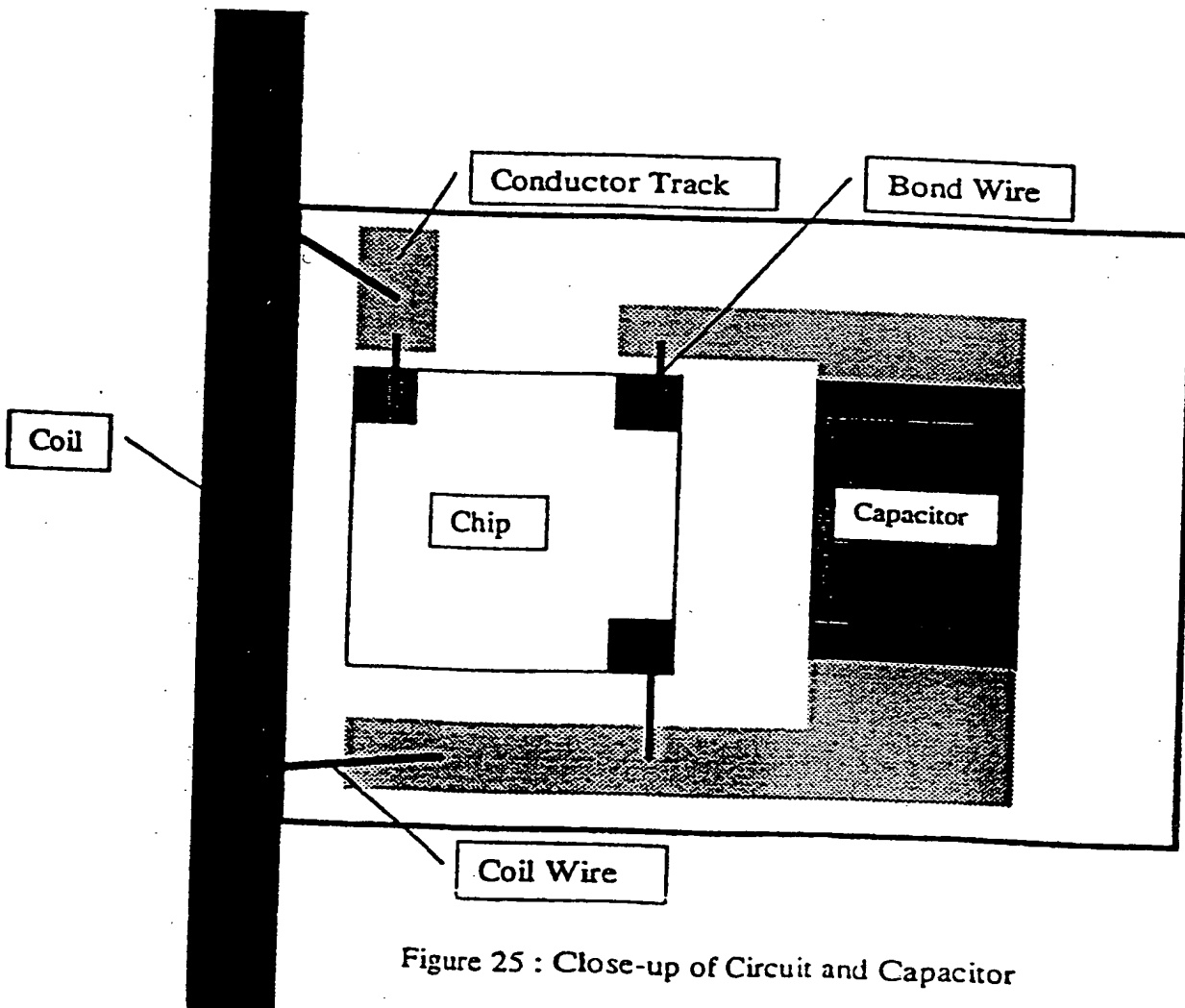
Figure 24 : Transponder Antenna Coil, Tuning Capacitor and Circuit

Figure 25 : Close-up of Circuit and Capacitor